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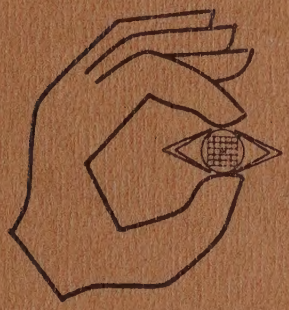

TELEQUIPMENT
OSCILLOSCOPE
SWEEP MODULE

TYPE S1

MANUAL

TELEQUIPMENT

SWEEP MODULE

TYPE S1

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TELEQUIPMENT

SWEEP MODULE

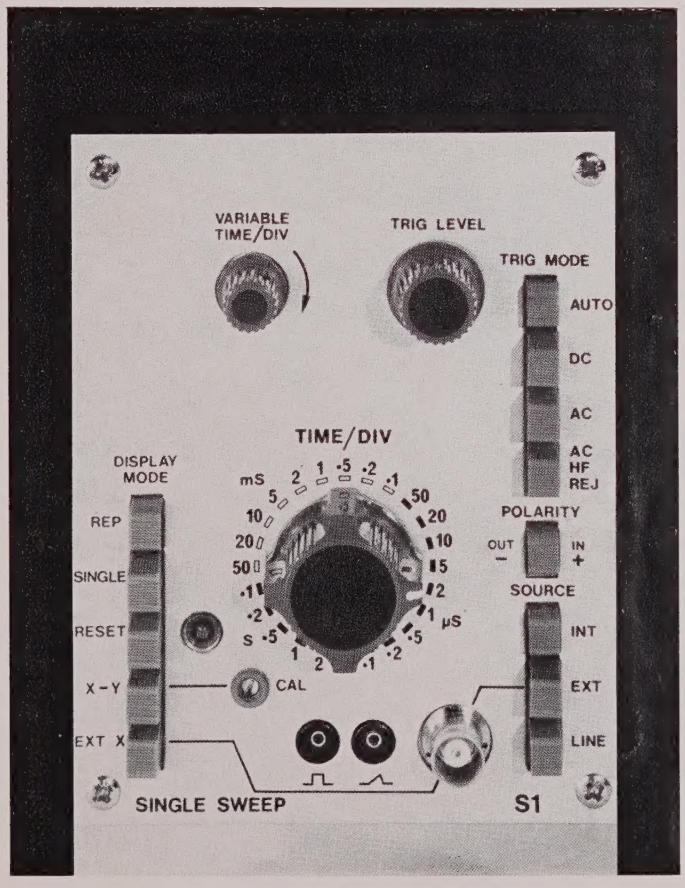
TYPE S1

INTRODUCTION

The S1, a single sweep module, provides the parent unit with a facility for an accurate time measurement of the input signals.

This manual should be read in conjunction with those manuals mentioned below. References are annotated "PU" and "V" for the parent unit and vertical modules respectively.

The design of this instrument is subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein. This would, in the main, affect the Components List and Circuit Diagram. The reader should pay particular attention to the notes at the beginning of Chapter 5.



NOTICE TO OWNER

To obviate the risk of damage during transit and facilitate packaging, do **NOT** send the following items unless they are suspect, should this Instrument be returned to TELEQUIPMENT for servicing.

Manual.

Probes.

Plug Assemblies.

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CHAPTER 1
SPECIFICATION

1.1 OPERATING MODE	Repetitive or Single shot
1.2 TRIGGER	
Auto	40 Hz - 50 MHz Trace freeruns in absence of signal
DC	D.C. - 50 MHz
AC	10 Hz - 50 MHz
H.F. reject	10 Hz - 2 MHz (−3 dB)
Sensitivity	
Internal	
L.F.	0·2 divisions
10 MHz	0·2 divisions
50 MHz	1 division
External	
L.F.	300 mV
10 MHz	300 mV
50 MHz	500 mV
Polarity	
+	from positive slope
−	from negative slope
Source	
Internal	from vertical amplifier
External	via Panel Jack
Line	locked to AC line frequency
1.3 SWEEP	
Range	
X1	2 s - 100 ns/div 1-2-5 sequence
X10	200 ms - 10 ns/div max.
Variable Control	
Sweep speed ratio	1 : 2·5
Accuracy	
X1	±3%
X10	±6% on all ranges
1.4 EXT X	
Sensitivity	
X1	400 mV/div ±15%
X10	40 mV/div ±20%
1.5 X - Y	used in conjunction with dual trace vertical modules
	CH1 to X } Phase difference CH2 to Y } between axes or vice-versa } <1° at 100 kHz
Bandwidth	DC - 1 MHz

CHAPTER 2
OPERATING INSTRUCTIONS

2.1.0 FUNCTION OF CONTROLS AND CONNECTORS

These are situated on the front panel except where otherwise specified. For those controls not covered below, reference should be made to Chapter 2 of the manual for the parent unit and "V" module.

2.1.1 CRT — refer to parent unit manual.

2.1.2 SWEEP

TIME/DIV — controls the speed of the respective sweeps. The sweep rates indicated are only valid if VARIABLE is fully clockwise and X10 is not selected. If X10 is selected and VARIABLE at CAL, the calibrations should be divided by 10 to ascertain the sweep speed.

VARIABLE — provides continuous coverage of sweep speeds in between those selected by TIME/DIV switch.

REP — pressed, selects repetitive triggering.

SINGLE — assists in viewing or photographing a non-recurrent signal. Upon application of a trigger pulse a single sweep only takes place. Sweep circuit is then disabled until the RESET button is pressed.

X - Y — used in conjunction with dual trace vertical modules. Connects CH1 to 'X' and CH2 to 'Y' or vice-versa.

CAL — sets X - Y gain in X direction.

2.1.3 TRIGGER

TRIG LEVEL — locks the trace.

TRIG MODE

Auto — provides a horizontal trace in the absence of signal by permitting the timebase to free run until signal is applied. LEVEL range is reduced to approximately 1 division.

AC or DC — relate to the coupling of the trigger circuit. For very low input frequency DC should be selected.

AC H.F. REJ — rejects progressively high frequency signals, permitting the trigger to respond to low frequency components of the triggering signal.

POLARITY

± — selects triggering from the positive or negative-going slope of a waveform.

SOURCE

INT and EXT — enable the sweep to be triggered either, internally from the vertical amplifier, or externally.

LINE — provides trigger signal at the power supply frequency.

2.1.4 VERTICAL — "V" manual.

2.1.5 CONNECTORS

INPUT

EXT TRIG / EXT X — Share a common input BNC socket located at the lower right, on the front panel. Signals are then applied to the required circuit by selection of either the EXT TRIG or EXT buttons.

OUTPUTS

SAWTOOTH — provides a positive-going ramp waveform when the sweep is running. A recurring sawtooth is produced when AUTO is selected. The resistance of an applied load should exceed 47 kΩ.

GATE OUT — provides a fast-edged positive-going rectanular pulse lasting for the duration of the sweep. The resistance of an applied load should exceed 4·7 kΩ.

2.2.0 PRE-OPERATIONAL CHECKS

2.2.1 SUPPLY — refer to parent unit manual.

2.2.2 CONTROL SETTING

1. CRT — refer to parent unit manual.
2. Set controls as follows:

SWEEP	REP
A ONLY	Depressed
TIME/DIV	5 ms
VARIABLE	Fully clockwise
TRIG MODE	Auto
POLARITY	Depressed
SOURCE	INT

2.3.0 OPERATION — Refer to parent unit manual.

CHAPTER 3
CIRCUIT DESCRIPTION

3.1.0 GENERAL

3.1.1 The S1 single sweep unit generates a precision timing current which, when applied to the sweep amplifier reference Figure 1 and unblanking amplifier reference Figure 2 enables the CRT to display a highly accurate sweep of controlled intensity. The unit may also be switched to provide X-Y displays or an external horizontal input.

The sweep generator and integral unblanking current generator provide either a repetitive or single sawtooth waveform to the horizontal amplifier simultaneously with an unblanking pulse of sweep duration, to permit only the sweep to be seen on the CRT. The flyback being blanked off.

In conjunction with a dual trace vertical amplifier the X-Y facility provides a continuous spot on the screen, this may be deflected along the X axis by a signal input to one vertical channel and deflected in the Y axis by the other Vert. channel. The X & Y channels being selected by the appropriate switches in the vertical system.

External X provides a continuous spot on the screen, which may be deflected in the X axis by an external signal applied via a panel BNC socket. Y deflection being obtained in the normal way from the vertical amplifier systems.

3.2.0 'A' SWEEP TRIGGER AMPLIFIER (FIG 1)

3.2.1 Will accept balanced trigger signals from the vertical amplifiers or single-ended external signals via a panel co-axial socket, SK1.

Balanced signals are fed into the trigger amplifier via a 150 Ω matched transmission line from the module edge connexion part of PC142 to S3B the X-Y switch, then to the balanced trigger amplifier, TR3 and TR4, via D.C. blocking capacitors C3 and C4, the INT/EXT switch S1, the POLARITY switch S2, and terminating resistors R13 and R31.

3.2.2 TR3 and TR4 form a long-tailed pair amplifier with a frequency compensation network R23 and C11, between the emitters, giving a gain lift at high frequencies. When S3d is set to HF/REJ the amplifier gain commences to fall at frequencies above 2 MHz, making the circuit unresponsive to HF noise spikes or other unwanted signals in the HF band.

'A' LEVEL, R22, provides emitter unbalance, this controls the bias level between TR3 and TR4 permitting selection of any point on the trigger signal to be set at a DC level, where the Schmitt amplifier TR6 and TR7 switches over. In the AUTO position, R22 is shunted by D4, R19, R29 and D6 with R21 in series with the wiper. The controlling effect of R22 is drastically reduced, thus enabling accurate setting of the trigger point of low amplitude signals.

3.2.3 Following TR4 is a frequency compensated shunt feedback stage formed by TR5, R26 and associated network, which is coupled via parasitic stoppers R35 and C15, to the Schmitt amplifier TR6, TR7, R36 and associated network. R26 sets the DC level of the Schmitt switch-over point when the TRIG level is in mid-position. R36 sets the hysteresis or voltage difference between the two potentials at which the Schmitt changes state.

Normal dividing down action takes place between 5 and 10 MHz depending upon the input amplitude. Two outputs are provided:—

(a) Fast positive and negative spikes via C61 to the bright-line monostable TR61 and TR62 (Fig. 2).
(b) Squarewave pulses (Fig. 2) to the sweep gating bistable TR63 and TR64 via C64 and D64.

3.2.4 Unbalanced trigger signals, originating from any external source, are applied to the sweep unit via a co-axial socket SK1 at an input impedance of 100 kΩ. The trigger amplifier is responsive to both DC and AC signals. By operation of S3; the DC component of an AC signal to the peak value of 250 V may be blocked. TR1 and TR2 form a single-ended shunt feedback pair, the output of which may be directed into the trigger amplifier or the horizontal amplifier in the parent unit. The parent unit is connected by operation of the push button switch S151d (Fig. 4). In all other positions TR1 and TR2 output is connected to the trigger amplifier via S151d normal, S1b, S1a and S2.

R7 provides adjustment of the DC level of external trigger signals at the Schmitt input to enable triggering from low amplitude inputs. Potential difference across D1 enables input socket SK1 to be held at approximately ground potential. TR1 & TR2 supply voltage is derived from a twin zener regulator, D3 and D8, fed from the main +24 V line via R12. Stray signals present are therefore prevented from entering the output signal of TR2.

3.2.5 In the EXT X position, TR3 and TR4 are disconnected from the −24 V line to prevent trigger signals from internal sources reaching the Schmitt amplifier. D5 permits current from the +100 V and + 24 V lines, to flow to ground.

3.3.0 'A' SWEEP GENERATOR (FIG 2)

3.3.1 This system is a conventional Miller Integrator TR66 and TR67, forming a basic ramp generator. Ramp slope is determinted by selection of timing capacitors C275 to C279, C281 and C282 (FIG. 3) and timing resistors R276 to R279, R281 to R283, R287 and R289, mounted on the TIME/DIV switch, S271. R91 enables accurate calibration of slow sweep speeds and C281 provides adjustment for fast speeds. R285 provides for speed adjustment in between calibrated sweep stages.

3.3.2 Sharply squared trigger pulses from the Trigger amplifier are passed through a differentiating network C64 and L61, which removes the DC component of the pulses, preserving the very fast edges. D4, being marginally biassed in the conducting direction, permits the fast positive-going edges to be applied to TR63 collector and TR64 base via C66. Negative-going edges are rejected by diode action. TR63 and TR64 form a gating bistable.

During the WAIT period, when the sweep generator is receptive to Trigger signals, TR63 is conducting and TR64 is off. The quiescent state of TR63 and TR64 is set by R73 which adjusts the bias of TR63 with respect to TR64. A positive spike being applied to TR64 causes it to conduct, and feedback action via the coupled emitter, R76 and C66 switches TR63 off. Collector potential of TR63 then rises rapidly to reverse

bias D64 and prevents further trigger pulses from entering the bistable. A positive going gate pulse is made available at the front panel via socket SK61.

3.3.3 TR65 has a dual role in the wait condition; as a clamp to the DC level from which the ramp commences and as a constant current generator once the ramp has commenced. The bias current flowing from TR65 collector, via D66, D69 and D71 to the timing resistors, is diverted through TR64, lowering the gate potential of the F.E.T. TR66 which reverse biases D66. D61 and D71 forming the equivalent to a very low leakage, low capacitance switch.

3.3.4 The TR66 drain voltage then commences to rise carrying TR67 base and emitter with it. The Miller loop is completed via the timing capacitors connected between TR67 emitter and TR66 gate. Positive feedback to increase loop gain is provided via R99 and R96, thus improving ramp linearity by reducing the potential excursion at TR66 gate and transferring it to the source electrode. The ramp voltage appearing at the emitter of TR67 is fed to the sweep-out circuit via S151a (Fig. 4); monitoring facilities being provided on the front panel via socket SK271. Also to the hold-off bistable TR66 and TR69, via D73 and the parallel combination C75, with R103, R104 and R105. TR69 is normally conducting, drawing part of its collector current through neon lamp V61, mounted on the front panel, causing it to glow during the wait and sweep period.

3.3.5 The ramp sweep terminates when TR68 base potential rises, via C79 and R11, to the same value as TR69 base potential, switching TR68 on TR69 off and extinguishing V61. TR69 no longer draws current via R118 and D75, causing D76 to conduct and momentarily increase the bias on TR63 to a value less negative than that on TR64. The two transistors then switch back to the state prior to receiving a trigger pulse. Flyback current then flows from TR65 to the timing capacitors via D66, D69 and D71, restoring the bias on TR66 gate and causing the ramp voltage to return rapidly to the quiescent condition.

3.3.6 As it is undesirable for the sweep to be triggered before flyback is completed, a time delay is achieved by switching a suitable capacitor mounted on S271, reference table 6.1 which holds-off the bistable TR68 and TR69 in the neon-off state, thus preventing TR64 being triggered to the conducting state. Hold-off capacitors C271 to C274 are charged during the sweep period via D73 and discharge during and after the flyback period via R103 to R106. R105 sets the sweep length. At the end of the hold-off period, TR68 and TR69 reverse conducting states, permitting the gating bistable TR63 and TR64, to be receptive to a trigger signal which initiates another sweep.

3.4.0 BRIGHT-LINE AUTO

3.4.1 TR61 and TR62 form a monostable pair in which TR62 is normally conducting and TR61 is off. When S3a is in the non-auto position, D63 is back biassed and exerts no influence on the bias of TR63.

3.4.2 In the AUTO position R68 is open circuited and the bias resistors R72 and R73 are shunted by R65, which lowers TR63 base bias to that of TR64, causing a switch over and the ramp to commence without the application of trigger pulses. At the end of the flyback and hold-off, TR63 and TR64 again switch over and another sweep will commence. The timebase free runs in the absence of trigger signals, giving visual indication of the trace position.

3.4.3 Upon the application of positive and negative trigger pulses from the Schmitt amplifier via C61, D61 being marginally forward biassed accepts and passes negative pulses to TR61 base, positive pulses being blocked by diode action. A negative pulse applied to TR61 base, causes TR61 to conduct and the collector potential to become positive-going, switching TR62 off through C63, a coupling capacitor. The time constant provided by C63 and R67 ensures that TR61 conducts for a period considerably longer than the negative trigger pulse duration, before switching back. The mean pulse current drawn by TR61 causes a mean potential rise across R65, smoothed by capacitor C62 to reverse bias D63 and prevent the gating bistable free running the sweep. In this condition the sweep is triggerable and the trace is locked to the input signal. D62 prevents TR6 bottoming during its conducting period ensuring an approximate cycling frequency of about 25 Hz.

3.5.0 UNBLANKING PULSE SOURCE

3.5.1 The unblanking pulse amplifier is a current to voltage convertor or transimpedance amplifier. Current input source for this amplifier is formed in the network D67, R89 and R93. Prior to the initiation of the sweep, D67 is reverse biassed by a clamp potential from TR65 via D66; no current flows from the unblanking amplifier, via D67, suppressing CRT beam current. At the commencement of the sweep, D66 is reverse biassed lowering the anode potential of D67 and permitting current from the unblanking amplifier to flow to the −24 V line via D67, R89 and R93. The CRT in the latter condition has its cathode to grid bias reduced to permit a visible trace to appear on the screen.

3.6.0 X - Y

3.6.1 Operation of S151c, the X - Y switch, diverts internally connected balanced signals originating in the vertical amplifier system to the horizontal amplifier. Signals which are in the same phase as the Y axis displays are switched by S151c, then via R156 (Fig. 4) a front panel gain control, and with the addition of a DC bias from the +24 V line via R155, are passed to the horizontal amplifier via R158, S151c, R152 and C151 and connection 2 on the rear edge of PC142. C151 provides phase correction of the vertical/horizontal display at frequencies less than 100 kHz. In this mode the time base generator and trigger amplifier are inoperative.

3.7.0 EXT X

3.7.1 With EXT X selected, signals applied to the front panel BNC socket are amplified by TR1 and TR2 and applied to the horizontal amplifier via S151d, S151c. R152, C151 and connection 2 on the rear edge of PC142. CRT unblanking in both the X - Y mode and EXT X mode being achieved by switching R78 (Fig. 2) to the −24 V line via contacts on S151c & d.

CHAPTER 4

MAINTENANCE AND CALIBRATION

4.1.0 GENERAL

4.1.1 This manual should be read in conjunction with the manuals for the parent unit and vertical module in use.

4.1.2 Before it is assumed a fault condition exists, control settings should be verified with reference to the pre-operational check, para. 2.2.0. Where components are replaced, e.g., transistors, it is advised that the calibration check detailed in para. 4.4.0 be carried out.

4.2.0 MECHANICAL

4.2.1. **ACCESS TO INTERIOR**

Withdraw module and remove covers.

4.2.2 **LOCATION OF PRESET CONTROLS**

Sweep and Trigger (PC143) are situated on the right.

4.3.0 CALIBRATION

4.3.1 The following procedure enables a calibration check of the module to be accomplished. It is advised that isolated adjustments are not made, due to risk of interaction with settings made in earlier checks. A functional check may be carried out as detailed in para. 4.4.0 below, checking parameters are met, then proceeding to the next check. Adjustments, if made, to obtain the parameters should be minimal.

The following tools and facilities will be required:

TOOLS

Screwdrivers	Plain 4 mm Blade.
	Insulated trimmer type.
Fixture	Extension, Module 067-0688-00.
Leads	Screened with BNC Adaptors.
Adaptors	BNC 3-way, Male/Female/Male.

Oscilloscope Monitor
Pliers flat nose
Termination 50 Ω.

FACILITIES

Variable voltage supply (Variac).

Input Signals	Markers
Sinewave	100 ms
300 mV 50 kHz	and
1 V 50 kHz	1-2-5 sequence
2 V 50 kHz	from 0·1 μs
150 kHz	to 2 S.
100 kHz	
10 MHz	
55 MHz	
20 MHz	
50 Hz AC Line	

4.3.2 **INITIAL SETTING**

(a) Push REP, AUTO and INT.
(b) Depress POLARITY
(c) Turn VARIABLE fully clockwise.
(d) Set TIME/DIV to 0·5 μs.

Note: Reference should be made to "PU" and "V" manuals for the respective initial settings.

4.4.0 CALIBRATION PROCEDURE

4.4.1 **TRIGGER AMPLIFIER**

Note: Withdraw sweep unit and connect to display unit with extension lead 067-0688-00. Remove unit covers.

1.0 Check Sensitivity

1.1 Push REP, AUTO and INT. Select Positive Polarity.
1.2 Set VARIABLE TIME/DIV to CAL, centralize LEVEL control.
1.3 Set TIME/DIV rotary switch to 10 μs/div.
1.4 Connect 300 mV, 50 kHz sinewave to V input.
1.5 Set vertical VOLTS/DIV 1 V.
1.6 Set DC-GND-AC to AC.
1.7 Connect Monitor oscilloscope (M.O.) to R35 (either end) via screened X10 probe, observe sinewave signal.
1.8 Adjust R26, PC143 until switching transients appear on sinewave signal as Plate 4.1.
1.9 Adjust R36, PC143 until transient vertical separation as Plate 4.1. 80mV apart
1.10 Select NEGATIVE polarity.
1.11 Check: Change of transient separation $< \pm 10$ mV.
1.12 Disconnect M.O. probe.

2.0 Check Stability.

2.1 Repeat Ops. 1.1, 1.2, 1.3 and 1.6.
2.2 Connect 1 V, 50 kHz sinewave to V input.
2.3 Set vertical VOLTS/DIV to 1 V.
2.4 Observe locked display on screen.
2.5 If display free running or absent, adjust R73. PC143 thus:
(a) Rotate R73 over whole range.
(b) Note setting range over which trace is locked.
(c) Set R73 midway in locked range.

3.0 Check LEVEL Control Range.

3.1 Repeat Ops. 1.1, 1.2, 1.3 and 1.6.
3.2 Connect 1 V, 50 kHz sinewave to V input.
3.3 Set VOLTS/DIV to 1 V.
3.4 Observe trigger point on 1 div display, rotate LEVEL.
3.5 Adjust R26, ~~PC132~~ PC143 to centralize LEVEL range within display amplitude.

Note: Loss of Trig may occur at LEVEL range extremities only.

4.0 Check External & Internal Trigger L/F.

4.1 Repeat Ops. 1.1, 1.2, 1.3, 1.6 and 2.3.
4.2 Connect 2 V, 50 kHz sinewave to V input and EXT Trig input.
4.3 Adjust LEVEL so that display starts half way up positive slope.
4.4 Adjust LEVEL whilst switching POLARITY for coincidence of trace start point as close as possible to position in Op. 4.3.
4.5 Push EXT source.
4.6 Check, trigger point coincides with Op. 4.4.
4.7 Adjust R7, PC132 whilst switching POLARITY to align start point to Op. 4.4.
4.8 Reduce 50 kHz input to 300 mV.
4.9 CHECK EXT trig, trace locks on DC, AC and AC H/F REJ using LEVEL control.
4.10 Push INT. Set input for 0·2 Div display.
4.11 CHECK INT. Trig, trace locks on DC, AC and AC H/F REJ using LEVEL control.

5.0 Check External & Internal Trigger H/F.

5.1 Repeat Ops. 1.1, 1.2 and 1.6.
5.2 Set TIME/DIV to 0·1 μSec.
5.3 Connect 55 MHz sinewave to CH1.
5.4 Adjust amplitude for 1 Div display.
5.5 Repeat Ops. 4.11 with exception of HF/REJ.

5.6 Connect 55 MHz to EXT X and CH1.
5.7 Push EXT and AUTO.
5.8 Set input voltage to 500 mV.
5.9 Adjust twisted wires above TR1 & TR2 until trace is triggerable by means of LEVEL adjustment.
5.10 Repeat Ops. 4.9 with exception of HF/REJ.

6.0 Check EXT X.
6.1 Push EXT X and repeat Ops. 2.3.
6.2 Connect 100 kHz sinewave to EXT X socket and V input.
6.3 Set DC-GND-AC switch to DC.
6.4 Set Trig MODE to DC and centralize display.
6.5 Increase 100 kHz input until trace touches extreme graticule limits.
6.6 CHECK vertical difference between trace extremities = 4 ± 0·8 Divs.

7.0 Check H/F Reject.
7.1 Repeat Ops. 1.1, 1.2, 1.6 and 5.2.
7.2 Connect 20 MHz sinewave signal to V input.
7.3 Set amplitude for an 8 div display.
7.4 Push H/F REJ.
7.5 CHECK display not triggerable using LEVEL control.

8.0 Check Line Trigger.
8.1 Repeat Ops. 1.1, 1.2 and 1.6.
8.2 Connect 50 Hz from A.C. line transformer secondary to V input.
8.3 Set TIME/DIV to 10 ms/Div.
8.4 Push LINE.
8.5 Adjust Volts/Div for 8 Div display.
8.6 By means of POLARITY switch and LEVEL input signal to be triggerable at all points on waveform.

4.4.2 SWEEP GENERATOR

1.0 Check Timing (L.F.).
1.1 Push REP, AUTO and INT. Select POSITIVE Polarity.
1.2 Set VARIABLE TIME/DIV to CAL, centralize LEVEL control.
1.3 Set TIME/DIV switch to 1 ms/Div.
1.4 Connect 1 ms Marker Signal to V input.
1.5 Set Volts/Div to give approximately 2 div trace.
1.6 Adjust LEVEL for locked trace.
1.7 CHECK Marker/Graticule alignment.
1.8 Adjust R91, PC143 and Horizontal Position control to align markers to graticule divisions.

2.0 Check Timing (H.F.).
2.1 Repeat Ops. 1.1 and 1.2.
2.2 Set TIME/DIV switch to ·1 μs/Div.
2.3 Connect 10 MHz sinewave signal, or ·1 μs markers to V input.
2.4 Set VOLTS/DIV to give approximately 2 div trace.
2.5 Adjust level for locked trace.
2.6 CHECK peak/graticule alignment.
2.7 Adjust C281; TIME/DIV switch (S271) via access hole adjacent to R36 and Horiz. Position Control to correct alignment.
2.8 Connect appropriate marker signals to V input to correspond with TIME/DIV.
2.9 Repeat Ops. 2.6 and 2.8 at each TIME/DIV position.
2.10 Adjust R91 and C281 if necessary to equalize maximum errors.

3.0 Check Single Shot.
3.1 Repeat 1.1 and 1.2, Push AC.
3.2 Connect 100 ms markers to V input.
3.3 Set VOLTS/DIV to display approximately 2 div trace.
3.4 Set DC-GND-AC to AC.
3.5 Set TIME/DIV to 0·2 s.
3.6 Adjust LEVEL for a locked trace.
3.7 Push SINGLE.
3.8 Observe single sweep only and neon extinguish.
3.9 Set DC-GND-AC to GND.
3.10 Push RESET.
3.11 Observe neon on, no sweep.
3.12 Set DC-GND-AC to AC.
3.13 Repeat Ops. 3.8.
3.14 Push REP.

4.0 Check Hold Off Time.
4.1 Set DC-GND-AC to GND.
4.2 Push AUTO.
4.3 Connect M.O. probe to pin 33, PC143.
4.4 Set TIME/DIV to 10 ms, 0·1 μs, 10 μs and 0·5 μs in turn.
4.5 Measure DC period between successive sawtooths at each speed in 4.4 (above).

Speed	Hold Off Period Limits
10 ms	4 ms — 8 ms
0·1 ms	60 ms — 120 μs
10 μs	6 μs — 12 μs
0·5 μs	1 μs — 2 μs

4.6 Adjust R108, PC143 to correct.

5.0 Check Variable Time.
5.1 Push REP, AC and INT. Select POSITIVE polarity.
5.2 Set VARIABLE TIME/DIV to CAL, centralize LEVEL control.
5.3 Connect marker generator to V input, 100 ms markers.
5.4 Set DC-GND-AC to AC.
5.5 Set TIME/DIV to 10 ms/Div.
5.6 Adjust LEVEL and VOLTS/DIV for 2 Div locked display.
5.7 Turn VARIABLE fully anti-clockwise.
5.8 CHECK, variation in TIME/DIV, ratio >2·5 : 1.
5.9 Repeat Ops. 5.2 and 5.6 to 5.8 for each TIME/DIV position slower than Ops. 5.5 above. Set markers to correspond with TIME/DIV setting.

4.4.3 X-Y MODE

1.0 Check X-Y Calibration.

Note 1: Remove sweep unit from extension lead, fit left hand cover to unit and insert into display unit.

2: A dual channel vertical unit to be used for this test.

1.1 Set VOLTS/DIV on both V inputs to 5 mV and DC.
1.2 Select CH1 display and CH2 trigger.
1.3 Connect 150 kHz sinewave signal to both V inputs.
1.4 Push X-Y.
1.5 Adjust channel position controls and signal input level so that diagonal display just touches extreme upper and lower graticule lines.
1.6 Adjust X-Y CAL on sweep unit front panel for 45° slope on display.
1.7 Adjust C151 on PC142 via access hole under C78 (PC143) for single diagonal line on display.
1.8 Select CH2 display and CH1 trigger, adjust C151 if necessary for single diagonal line as in 1.7 above.
1.9 Repeat Ops. 1.2, 1.7 and 1.8 for single diagonal under both conditions.

CHAPTER 5

COMPONENT LIST

Values of resistors are stated in ohms or multiples of ohms; ratings at 70°C are in watts or sub-multiples of watts. Values of capacitors are stated in sub-multiples of farads; ratings at 70°C are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternative may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument type.
2. Instrument serial number.
3. Component circuit reference.
4. Component part number.
5. Component Value.

ABBREVIATIONS

BM	Button mica	CMP	Cermet preset	PS	Polystyrene
C	Carbon	E	Electrolytic	Se	Selenium
CP	Carbon preset	Ge	Germanium	Si	Silicon
CV	Carbon variable	MF	Metal film	SM	Silver mica
CER	Ceramic	MO	Metal oxide	WW	Wire-wound
CT	Ceramic trimmer	PE	Polyester	WWP	Wire-wound preset
CM	Cermet thick film	PP	Polypropylene	WWV	Wire-wound variable

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All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service.

ELECTRICAL

Clr Ref	Part Number	Value F	Type	Tol	Rating Volts
C1	285-0946-00	470 n	PE	20%	250
C2	285-0796-00	100 n	PE	20%	250
C3	290-0623-00	4·7 μ	ELEC		40
C4	290-0623-00	4·7 μ	ELEC		40
C5	290-0623-00	4·7 μ	ELEC		40
C6	285-0915-00	100 n	PE	20%	100
C7	285-0915-00	100 n	PE	20%	100
C9	281-0710-00	10 n	CER		250
C11	285-0847-00	560 p	PS	5%	125
C12	281-0710-00	10 n	CER		250
C13	285-0920-00	56 p	PS	2 p	350
C14	290-0627-00	22 μ	ELEC		40
C15	285-0842-00	15 p	PS	1 p	350
C61	285-0871-00	150 p	PS	5%	350
C62	290-0627-00	22 μ	ELEC		40
C63	285-0779-00	470 n	PE	20%	100
C64	281-0710-00	10 n	CER		250
C65	285-0940-00	12 p	PS	1 p	350
C66	285-0845-00	68 p	PS	2 p	350
C67	285-0854-00	100 p	PS	2 p	350
C68	281-0710-00	10 n	CER		250
C71	285-0776-00	27 p	PS	1 p	350
C72	285-0836-00	47 n	PE	20%	250

Clr Ref	Part Number	Value F	Type	Tol	Rating Volts
C73	281-0734-00	100 n	CER		30
C74	281-0711-00	3·9 p	CER	0·25 p	750
C75	285-0940-00	12 p	PS	1 p	350
C76	285-0866-00	10 p	PS	1 p	350
C77	281-0710-00	10 n	CER		250
C78	285-0867-00	20 p	PS	1 p	350
C79	285-0869-00	47 p	PS	2 p	350
C81	285-0873-00	200 p	PS	5%	350
C151	281-0155-00	2-22 p			500
C152	285-0915-00	100 n	PE	20%	100
C271	285-0792-00	4·7 n	PE	20%	125
C272	285-0874-00	470 p	PS	5%	125
C273	285-0786-00	33 p	PS	2 p	350
C274	285-0791-00	470 n	PE	10%	125
C275	285-1023-00	9 n	PC	1%	400
C276	281-0738-00	20 p	CER	0·25 p	750
C277	283-0721-00	900 p	SM	1%	350
C278	285-0943-00	1 μ	PC	1%	63
C279	283-0722-00	60 p	SM	1%	350
C281	281-0732-00	3-12 p	CE		250
C282	283-0723-00	10 p	SM	0·5 p	350

Clr Ref	Part Number	Value	Description	Type	Tol	Rating
D1	152-0062-01		IN914	Si		
D2	152-0062-01		IN914	Si		
D3	152-0472-00	5·6 V	Zener	Si	5	330 mW
D4	152-0062-01		IN914	Si		
D5	152-0062-01		IN914	Si		
D6	152-0062-01		IN914	Si		
D7	152-0348-00	6·2 V	Zener BZY88	Si	5	330 mW
D8	152-0472-00	5·6 V	Zener	Si	5	330 mW
D61	152-0062-01		IN914	Si		
D62	152-0062-01		IN914	Si		
D63	152-0062-01		IN914	Si		
D64	152-0062-01		IN914	Si		
D65	152-0062-01		IN914	Si		
D66	152-0062-01		IN914	Si		
D67	152-0062-01		IN914	Si		
D69	152-0541-00		BAY82	Si		
D71	152-0483-00		CE1104 XK1045	Si		
D72	152-0062-01		IN914	Si		
D73	152-0062-01		IN914	Si		
D74	152-0062-01		IN914	Si		
D75	152-0062-01		IN914	Si		
D76	152-0062-01		IN914	Si		
L1	108-0720-00	7·7 μH	Inductor Fixed			
L2	108-0433-00	16 μH	Inductor Fixed			
L61	108-0481-00	1·3 μH	Inductor Fixed			

Cir Ref	Part Number	Value Ohms	Type	Tol %	Rating W
R1	317-0104-01	100 k	C	5	125 m
R2	317-0103-01	10 k	C	5	125 m
R3	317-0183-01	18 k	C	5	125 m
R4	317-0513-01	51 k	C	5	125 m
R5	315-0433-02	43 k	C	5	250 m
R6	317-0432-01	4·3 k	C	5	125 m
R7	311-0995-00	680	CP	20	250 m
R8	317-0201-01	200	C	5	125 m
R9	317-0562-01	5·6 k	C	5	125 m
R10	317-0102-01	1 k	C	5	125 m
R11	317-0151-01	150	C	5	125 m
R12	317-0621-01	620	C	5	125 m
R13	317-0750-01	75	C	5	125 m
R14	317-0153-01	15 k	C	5	125 m
R15	317-0123-01	12 k	C	5	125 m
R16	317-0100-01	10	C	5	125 m
R17	317-0392-01	3·9 k	C	5	125 m
R18	317-0822-01	8·2 k	C	5	125 m
R19	317-0752-01	7·5 k	C	5	125 m
R21	317-0562-01	5·6 k	C	5	125 m
R22	311-1354-00	6·8 k	CV	20	40 m
R23	317-0101-01	100	C	5	125 m
R24	317-0822-01	8·2 k	C	5	125 m
R25	317-0104-01	100 k	C	5	125 m
R26	311-0802-00	4·7 k	CP	20	250 m
R27	317-0123-01	12 k	C	5	125 m
R28	317-0100-01	10	C	5	125 m
R29	317-0222-01	2·2 k	C	5	125 m
R31	317-0750-01	75	C	5	125 m
R32	317-0511-01	510	C	5	125 m
R33	317-0122-01	1·2 k	C	5	125 m
R34	317-0153-01	15 k	C	5	125 m
R35	317-0100-01	10	C	5	125 m
R36	311-1388-00	47	CP	20	250 m
R38	317-0220-01	22	C	5	125 m
R39	317-0182-01	1·8 k	C	5	125 m
R41	317-0101-01	100	C	5	125 m
R42	317-0100-01	10	C	5	125 m
R43	317-0223-01	22 k	C	5	125 m
R62	317-0153-01	15 k	C	5	125 m
R63	317-0105-01	1 M	C	5	125 m
R64	317-0682-01	6·8 k	C	5	125 m
R65	317-0393-01	39 k	C	5	125 m
R66	317-0203-01	20 k	C	5	125 m
R67	317-0473-01	47 k	C	5	125 m
R68	317-0101-01	100	C	5	125 m
R69	317-0392-01	3·9 k	C	5	125 m
R71	317-0622-01	6·2 k	C	5	125 m
R72	317-0153-01	15 k	C	5	125 m
R73	311-0735-00	10 k	CP	20	250 m
R74	317-0682-01	6·8 k	C	5	125 m
R75	317-0331-01	330	C	5	125 m
R76	317-0332-01	3·3 k	C	5	125 m
R77	317-0472-01	4·7 k	C	5	125 m
R78	321-0291-48	10·5 k	MF	1	125 m
R79	317-0470-01	47	C	5	125 m
R80	317-0471-01	470	C	5	125 m

Cir Ref	Part Number	Value Ohms	Type	Tol %	Rating W
R81	317-0183-01	18 k	C	5	125 m
R82	317-0392-01	3·9 k	C	5	125 m
R83	317-0473-01	47 k	C	5	125 m
R84	317-0472-01	4·7 k	C	5	125 m
R85	321-0373-48	75 k	MF	1	125 m
R86	317-0823-01	82 k	C	5	125 m
R88	317-0562-01	5·6 k	C	5	125 m
R89	321-0291-48	10·5 k	MF	1	125 m
R91	311-0798-00	2·2 k	CP	20	250 m
R93	317-0394-01	390 k	C	5	125 m
R94	317-0221-01	220	C	5	125 m
R95	317-0101-01	100	C	5	125 m
R96	317-0221-01	220	C	5	125 m
R97	317-0562-01	5·6 k	C	5	125 m
R98	317-0154-01	150 k	C	5	125 m
R99	317-0203-01	20 k	C	5	125 m
R101	316-0475-01	4·7 M	C	10	250 m
R102	317-0225-01	2·2 M	C	5	125 m
R103	317-0433-01	43 k	C	5	125 m
R104	317-0473-01	47 k	C	5	125 m
R105	311-0750-00	22 k	CP	20	250 m
R106	317-0393-01	39 k	C	5	125 m
R107	317-0122-01	1·2 k	C	5	125 m
R108	311-0851-00	1 k	CP	20	250 m
R109	317-0222-01	2·2 k	C	5	125 m
R111	317-0243-01	24 k	C	5	125 m
R112	317-0512-01	5·1 k	C	5	125 m
R113	317-0105-01	1 M	C	5	125 m
R114	317-0433-01	43 k	C	5	125 m
R115	317-0513-01	51 k	C	5	125 m
R116	317-0104-01	100 k	C	5	125 m
R117	317-0753-01	75 k	C	5	125 m
R118	317-0302-01	3 k	C	5	125 m
R151	317-0103-01	10 k	C	5	125 m
R152	317-0332-01	3·3 k	C	5	125 m
R153	321-0306-48	15 k	MF	1	125 m
R154	317-0103-01	10 k	C	5	125 m
R155	317-0822-01	8·2 k	C	5	125 m
R156	311-1519-00	2·2 k	CP	20	15 m
R157	317-0222-01	2·2 k	C	5	125 m
R158	317-0620-01	620	C	5	125 m
R159	317-0473-01	47 k	C	5	125 m
R161	317-0473-01	47 k	C	5	125 m
R271	317-0302-01	3 k	C	5	125 m
R272	317-0332-01	3·3 k	C	5	125 m
R273	317-0562-01	5·6 k	C	5	125 m
R274	317-0183-01	18 k	C	5	125 m
R275	321-0355-48	48·7 k	MF	1	125 m
R276	324-0594-40	15 M	MF	1	1
R277	324-0616-40	7·5 M	MF	1	1
R278	324-0544-40	4·53 M	MF	1	1

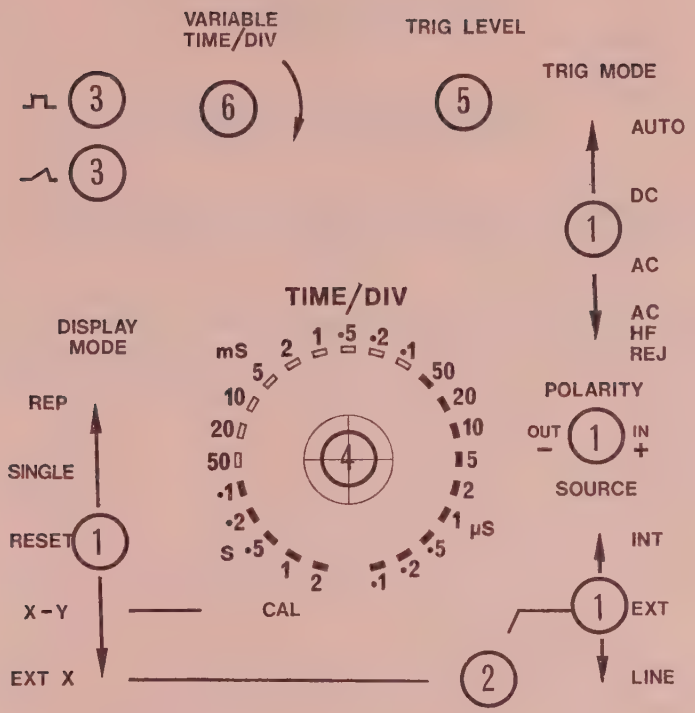
Cir Ref	Part Number	Value Ohms	Type	Tol %	Rating W
R279	322-0498-40	1·5 M	MF	1	250 m
R281	321-0469-48	750 k	MF	1	125 m
R282	321-0448-48	453 k	MF	1	125 m
R283	321-0402-48	150 k	MF	1	125 m
R284	321-0402-48	150 k	MF	1	125 m
R285	311-1355-00	100 k	CV	20	125 m
R286	317-0223-01	22 k	C	5	125 m
R287	321-0402-48	150 k	MF	1	125 m
R288	317-0103-01	10 k	C	5	125 m
R289	317-0154-01	150 k	C	5	125 m
TH1	307-0270-00	330	Thermistor 20% at 25°C		

Cir Ref	Part Number	Description
S1	260-1403-00	Push (3 button)
S2	260-1401-00	Push (1 button)
S3	260-1402-00	Push (4 button)
S151, S152	260-1536-00	Push (5 button)
S271	260-1410-00	Rotary (23 position)
SK1	131-0650-01	Socket BNC
SK61	131-1268-00	Socket 2 mm.
SK271	131-1268-00	Socket 2 mm.

Cir Ref	Part Number	Description		Type
TR1	151-0127-02	BSX20	Si	NPN
TR2	151-0320-01	MP56518	Si	PNP
TR3	151-0127-02	BSX20	Si	NPN
TR4	151-0127-02	BSX20	Si	NPN
TR5	151-0320-01	MPS6518	Si	PNP
TR6	151-0127-02	BSX20	Si	NPN
TR7	151-0127-02	BSX20	Si	NPN
TR61	151-0320-01	MPS6518	Si	PNP
TR62	151-0320-01	MPS6518	Si	PNP
TR63	151-0127-02	BSX20	Si	NPN
TR64	151-0127-02	BSX20	Si	NPN
TR65	151-0320-01	MPS6518	Si	PNP
TR66	151-1062-00	F.E.T.	Si	N can
TR67	151-0242-00	2N3904	Si	NPN
TR68	151-0317-00	BC109C	Si	NPN
TR69	151-0242-00	2N3904	Si	NPN
V61	150-0138-00	Neon Indicator 90 V DC		

ASSEMBLIES

Assembly	Part No.	Includes Circuit References
Display mode PC142	670-2868-00	C151, C152, R151 to R159, R161, S151, S152.
Sweep PC143	670-2869-00	As listed in Chapter 5, less those listed in this table.
Time/Div Switch	262-0958-00	PC136, S271.
Time Resistor PC136	670-2190-01	R271 to R279, R281 to R283.



PANEL, FRONT.

MECHANICAL

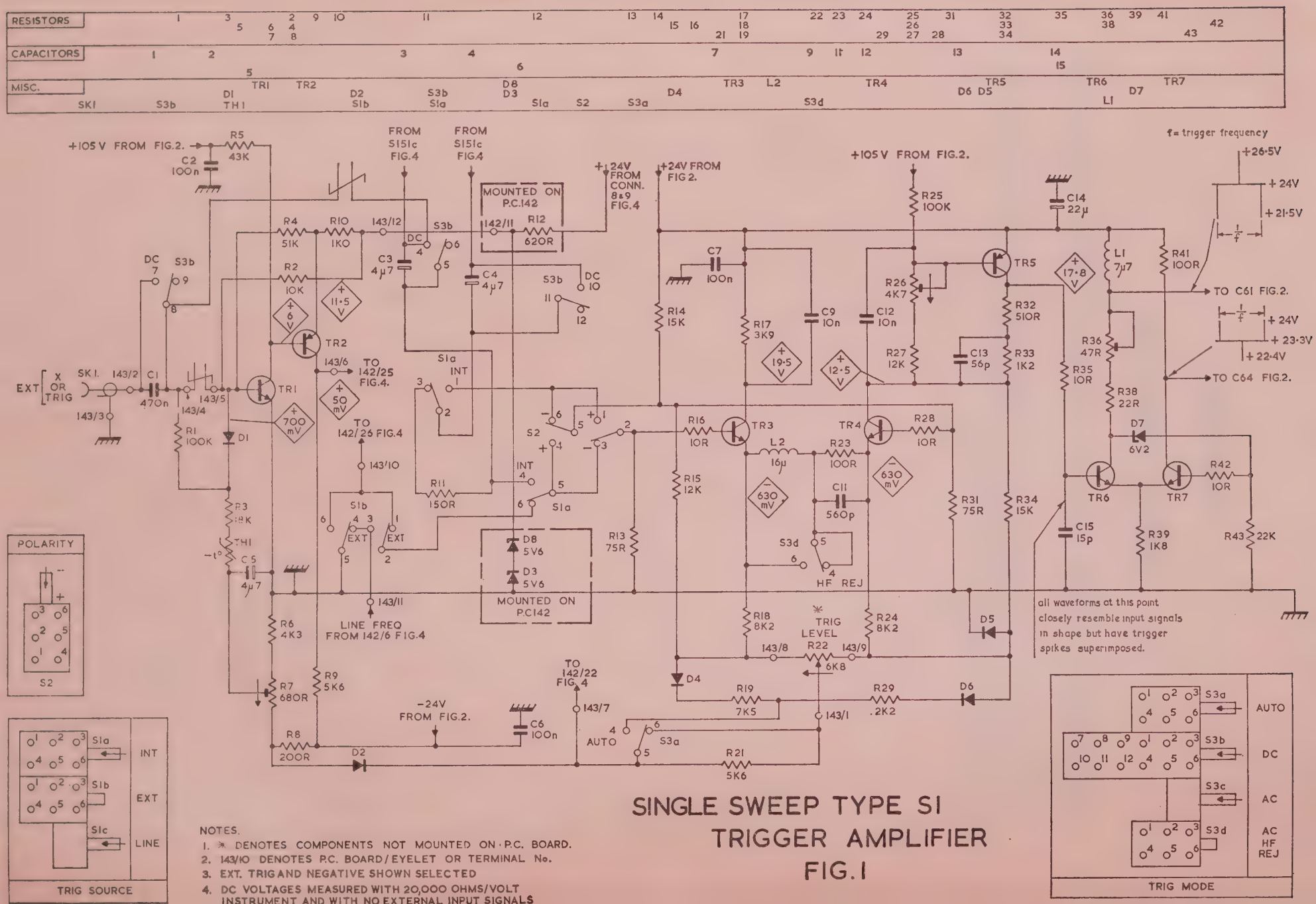
Part Number	Description	Location
366-1403-00	Button, Push	1
131-0650-01	Connector, Bulkhead Socket BNC	2
131-1268-00	Connector, Single Pole 2 mm	3
131-0649-00	Connector, Male BNC	Accessory
210-0726-00	Eyelet LE2	PC142
210-0735-00	Eyelet L613	PCB
210-0739-00	Eyelet L737	PCB
003-0674-00	Key, Allen 1·5 mm A/F	4, 5, 6
366-1241-00	Knob, Grey/Black	4
366-1421-00	Knob, Grey/Black	5
366-1239-02	Knob, Grey/Red	6
220-0527-00	Nut, Chrome	4, 5, 6
220-0692-00	Nut	Front Panel
004-1143-00	Packaging	Accessory
213-0248-00	Screw, Socket, 3 x 3 mm	6 - 10
361-0223-00	Spacer, 6 BA Captive	PC143
105-0347-00	Stop	Rear of Mod
210-0275-00	Tag, Solder, ⅜"	

CHAPTER 6

CIRCUIT DIAGRAMS

To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2·2 megohms is shown as 2M2 and 1·8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Chapter 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.



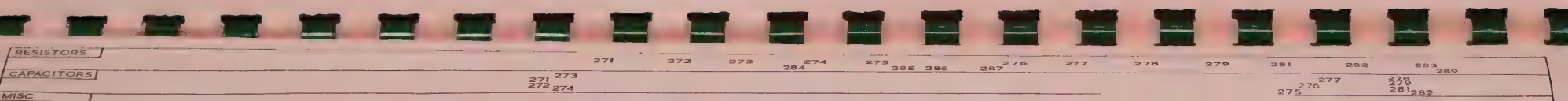
SINGLE SWEEP TYPE S1 TRIGGER AMPLIFIER FIG.1

NOTES.

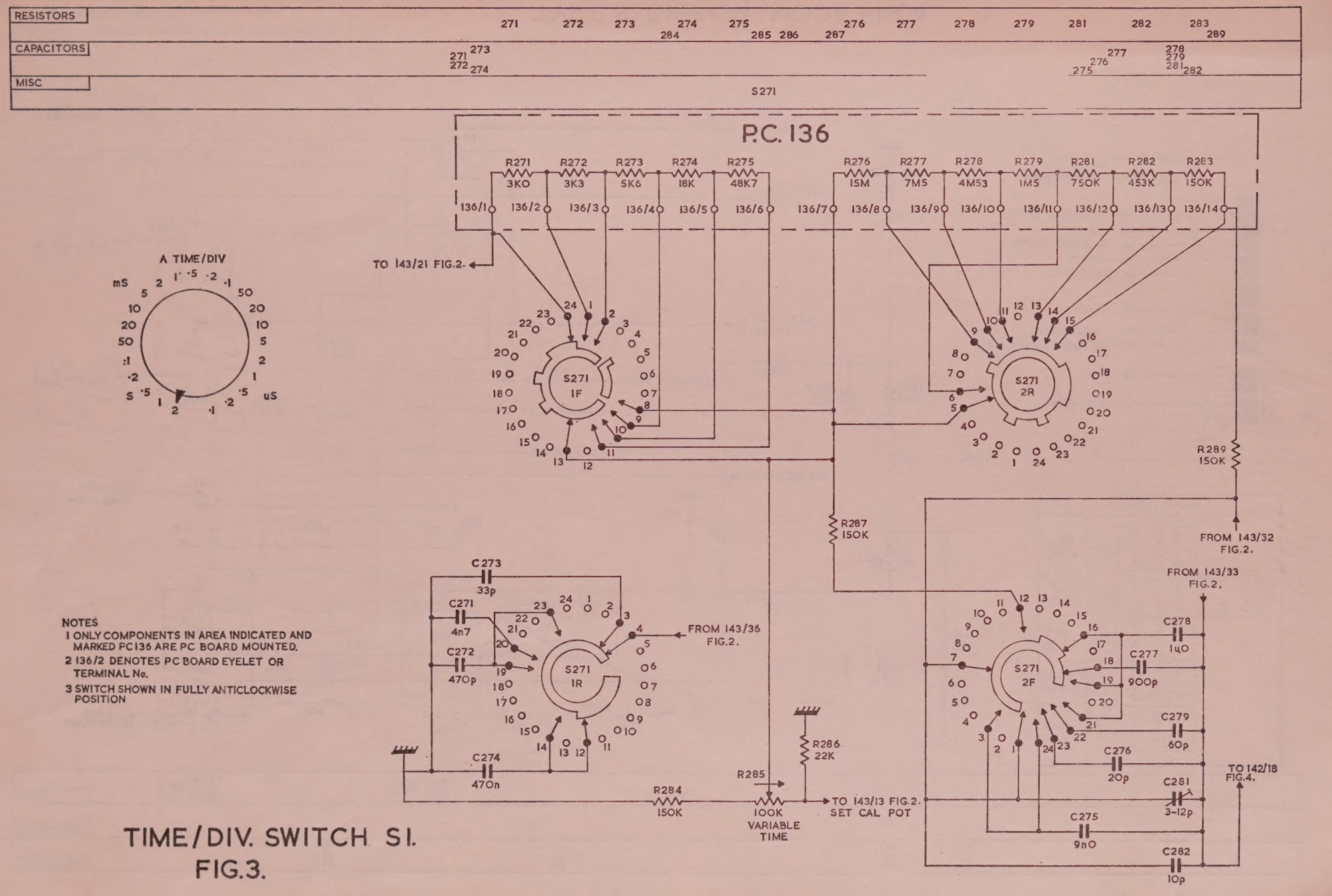
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 143/10 DENOTES P.C. BOARD / EYELET OR TERMINAL No.
3. EXT. TRIG AND NEGATIVE SHOWN SELECTED
4. DC VOLTAGES MEASURED WITH 20,000 OHMS/VOLT INSTRUMENT AND WITH NO EXTERNAL INPUT SIGNALS

POSITION	R285 Loading Resistors Selected by Wafer 1F	Timing Resistors Selected by Wafer 2R	Hold Off Capacitor Selected by Wafer 1R	Timing Capacitors Selected by Wafer 2F
2 s	—	R276, R277, R278, R279, R281, R282, R283	C273 C274	C277, C278
1 s	—	R277, R278, R279, R281, R282, R283	C273 C274	C277, C278
0·5 s	—	R278, R279, R281, R282, R283	C273 C274	C277, C278
0·2 s	R271	R279, R281, R282, R283	C273, C274	C277, C278, C279
0·1 s	R271, R272	R281, R282, R283	C273, C274	C276, C277, C278, C279
50 ms	R271, R272, R273	R282, R283	C273, C274	C276, C277, C278, C279
20 ms	R271, R272, R273, R274	R283	C273, C274	C276, C277, C278, C279
10 ms	R271, R272, R273, R274, R275	—	C272, C273, C274	C276, C277, C278, C279
5 ms	—	R278, R279, R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
2 ms	R271	R279, R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
1 ms	R271, R272	R281, R282, R283	C271, C272, C273	C275, C276, C277, C279
·5 ms	R271, R272, R273	R282, R283	C271, C272, C273	C275, C276, C277, C279
·2 ms	R271, R272, R273, R274	R283	C271, C272, C273	C275, C276, C277, C279
·1 ms	R271, R272, R273, R274, R275	—	C271, C272, C273	C275, C276, C277, C279
50 μs	R271, R272, R273	R282, R283	C272, C273	C276, C277, C279
20 μs	R271, R272, R273, R274	R283	C272, C273	C276, C277, C279
10 μs	R271, R272, R273, R274, R275	—	C272, C273	C276, C277, C279
5 μs	R271, R272, R273	R282, R283	C273	C276, C279
2 μs	R271, R272, R273, R274	R283	C273	C276, C279
1 μs	R271, R272, R273, R274, R275	—	C273	C276, C279
·5 μs	—	—	C273	C276, C279
·2 μs	—	—	—	C276
·1 μs	—	—	—	—

TABLE — TIME/DIV SWITCH CONNEXIONS


RESISTORS
271
272
273
274
284
275
285
286
287
276
277
278
279
281
282
283
269
CAPACITORS
271
272
273
274
276
277
275
278
279
281
282
MISC

RESISTORS	271 272 273 274 275 276 277 278 279 281 282 283 284 285 286 287 289
CAPACITORS	271 272 273 274 275 276 277 278 279 281 282
MISC	S271



NOTES

1 ONLY COMPONENTS IN AREA INDICATED AND MARKED PC136 ARE PC BOARD MOUNTED.

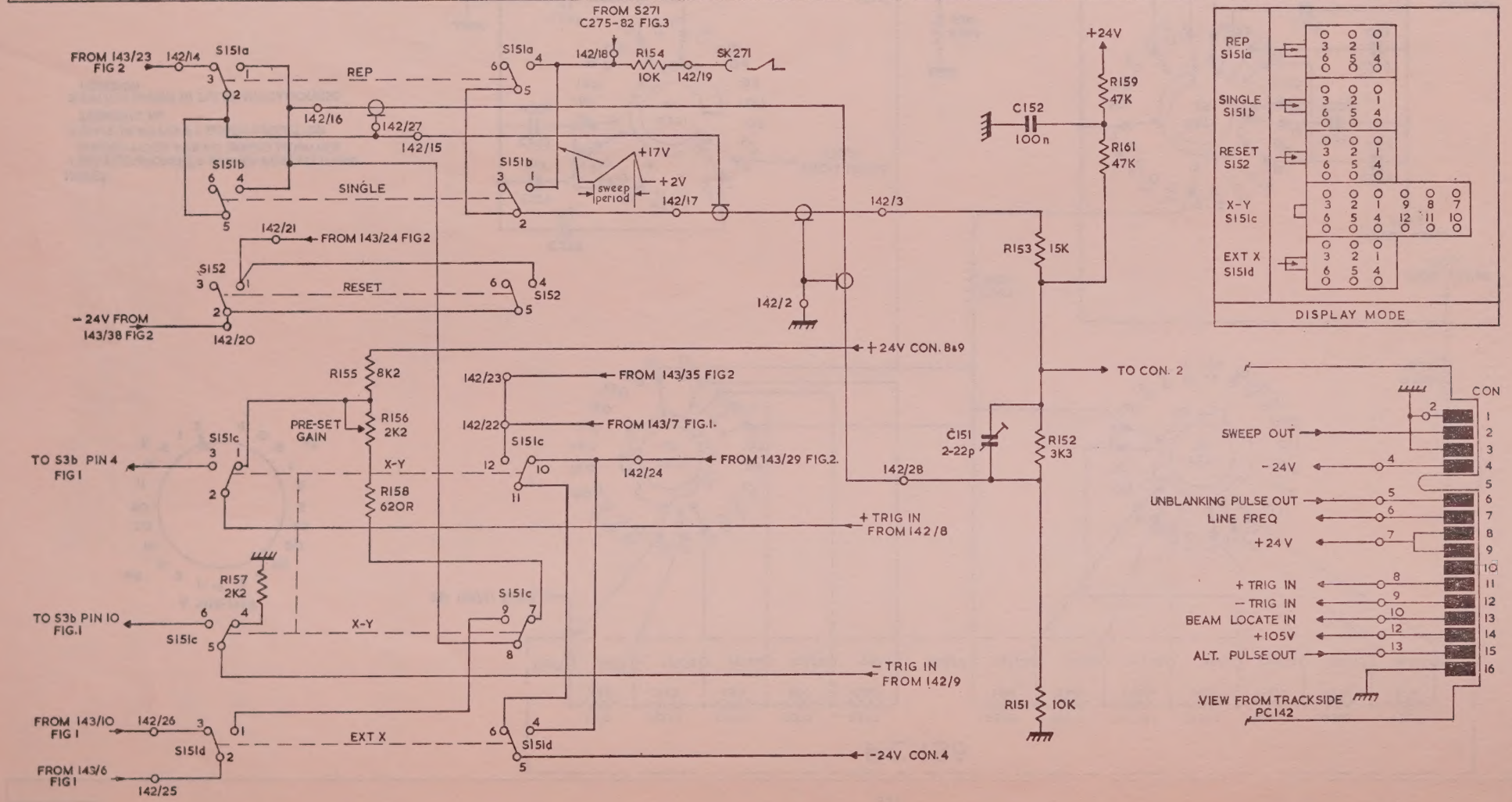
2 136/2 DENOTES PC BOARD EYELET OR TERMINAL No.

3 SWITCH SHOWN IN FULLY ANTICLOCKWISE POSITION

TIME/DIV. SWITCH S1.

FIG.3.

RESISTORS	157	155 156 158	154	153 152 151	159 161
CAPACITORS				151 152	
MISC	S151c S151a S151d S151b S152		S151c S151a S151d S151b S152		



NOTES.

1. 142/1 INDICATES PC BOARD/EYELET OR TERMINAL No.
2. X-Y SHOWN SELECTED

TYPE SI DISPLAY MODE FIG. 4.

TELEQUIPMENT

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